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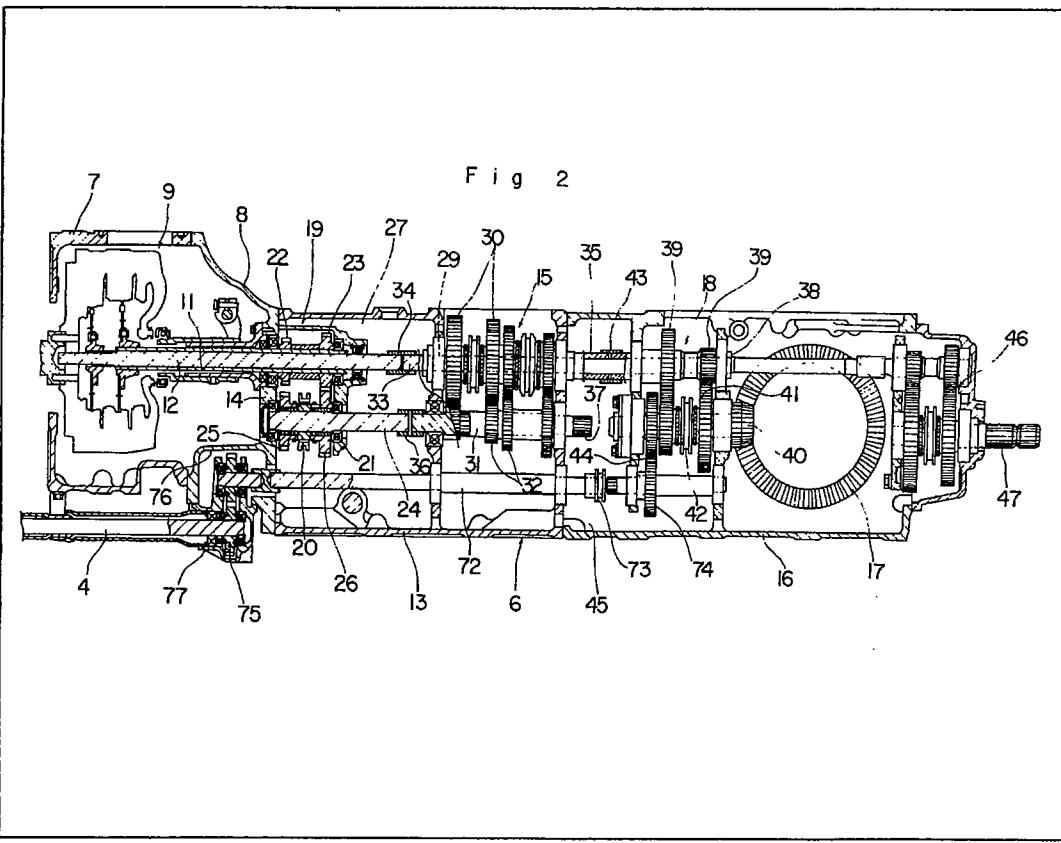
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(54) Tractor transmission including interchangeable gearing

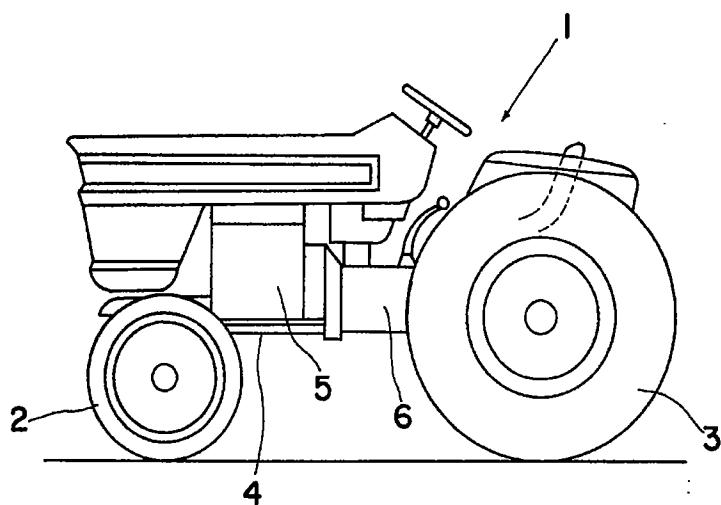
(57) A tractor transmission wherein an engine output is transmitted through a clutch mechanism 9 to a primary change speed mechanism 15, and a clutch housing 8 and a first transmission case 13 are removably connected to each other. The first transmission case includes a space 27 in a forward portion thereof to accommodate a high speed and low speed switching mechanism (48) (not shown) or a forward and backward switching mechanism 19, interchangeable with each other, to be attached to a rear wall of the clutch housing 8.



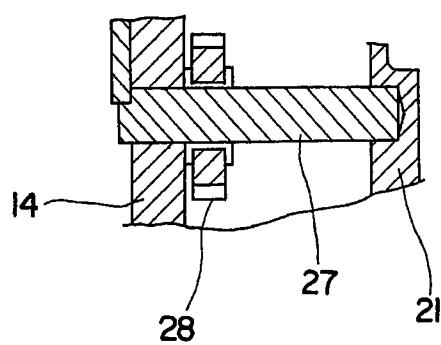
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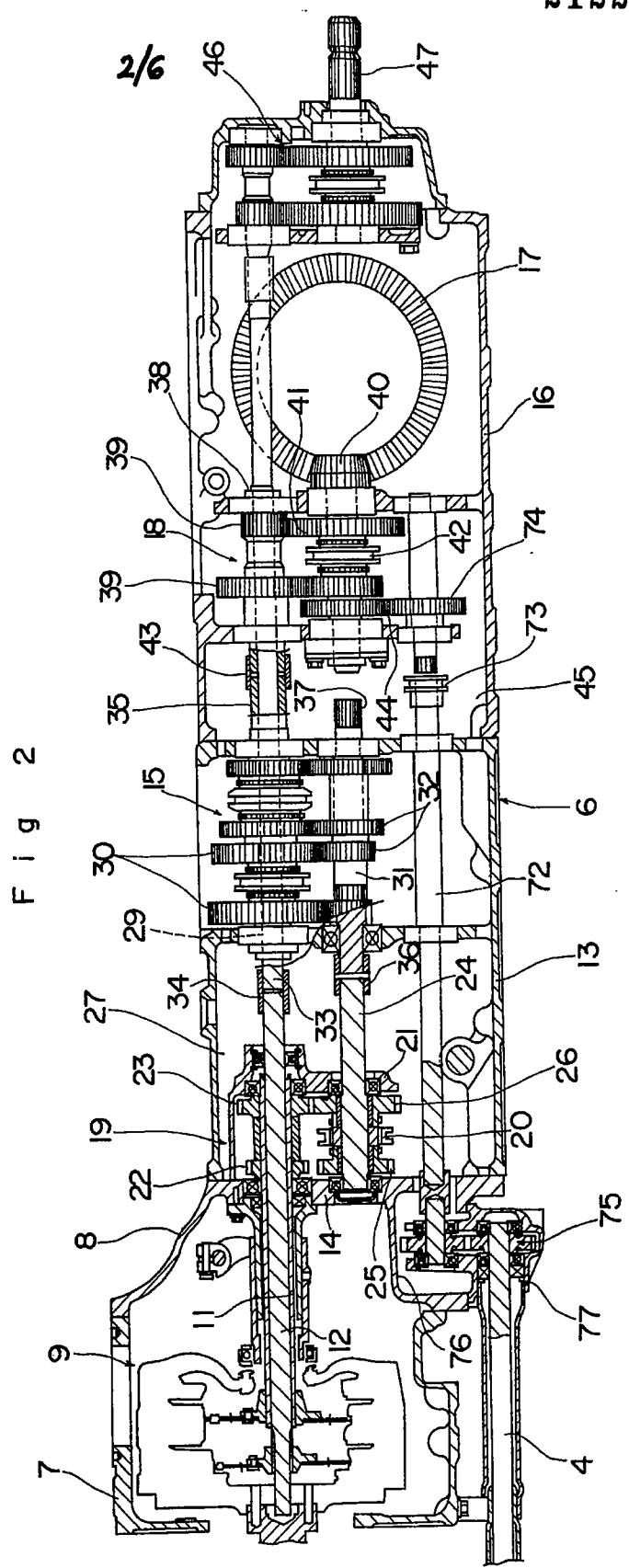
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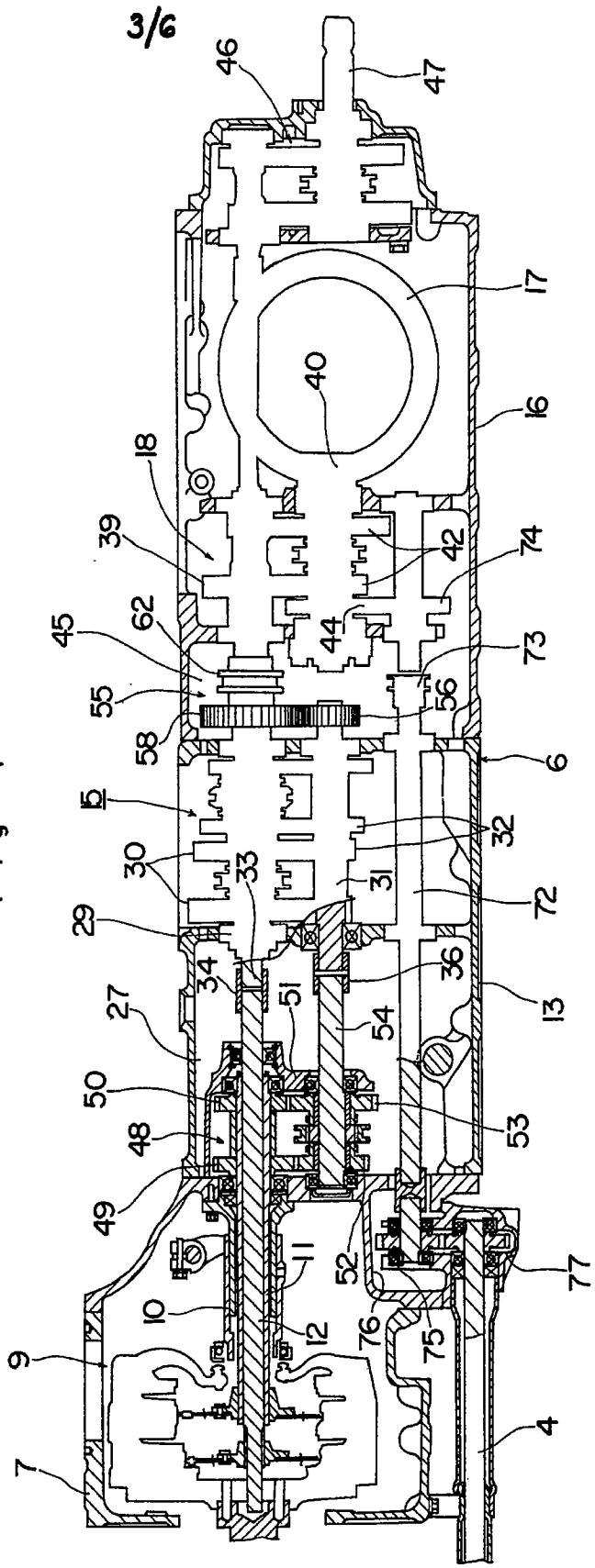
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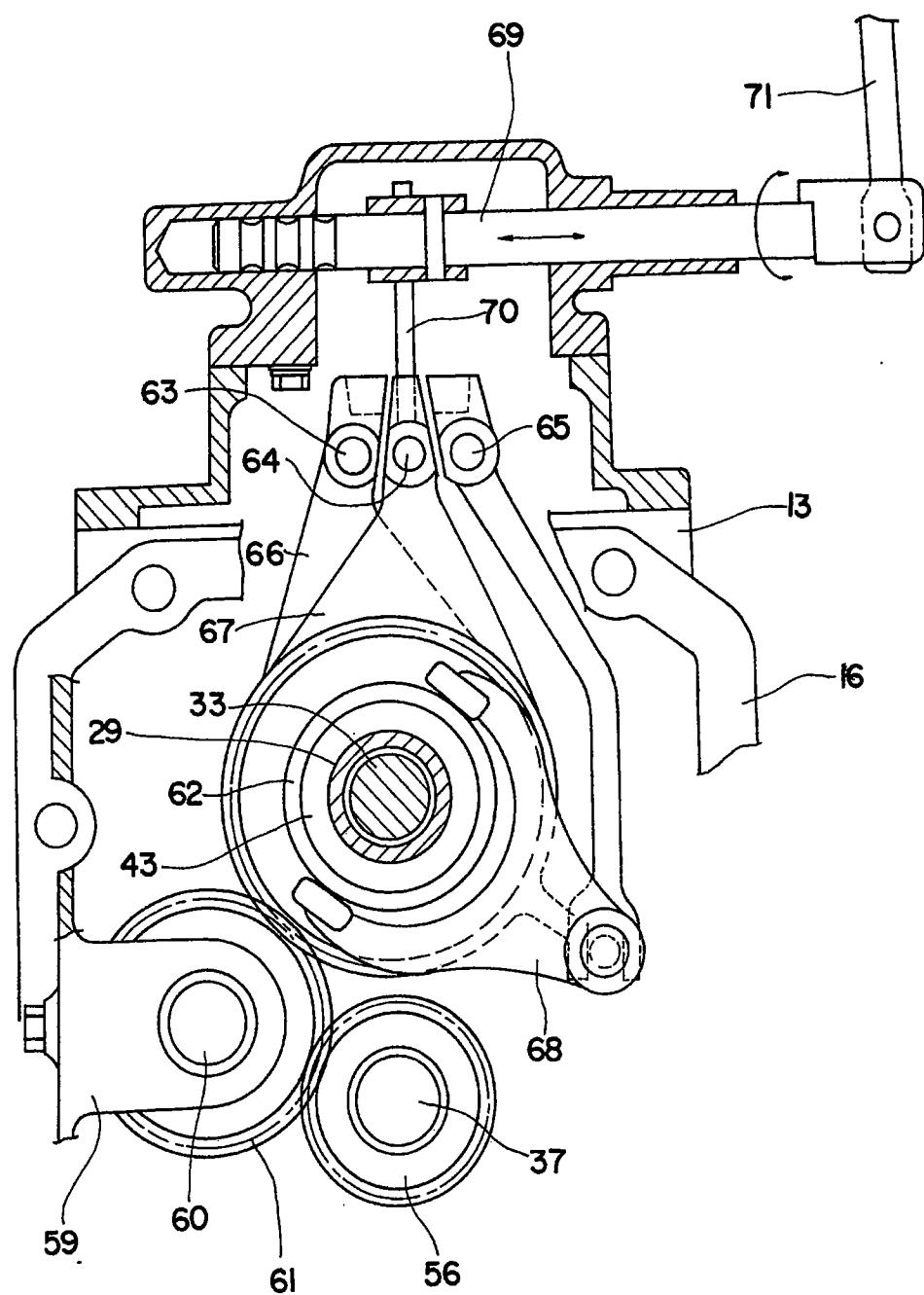
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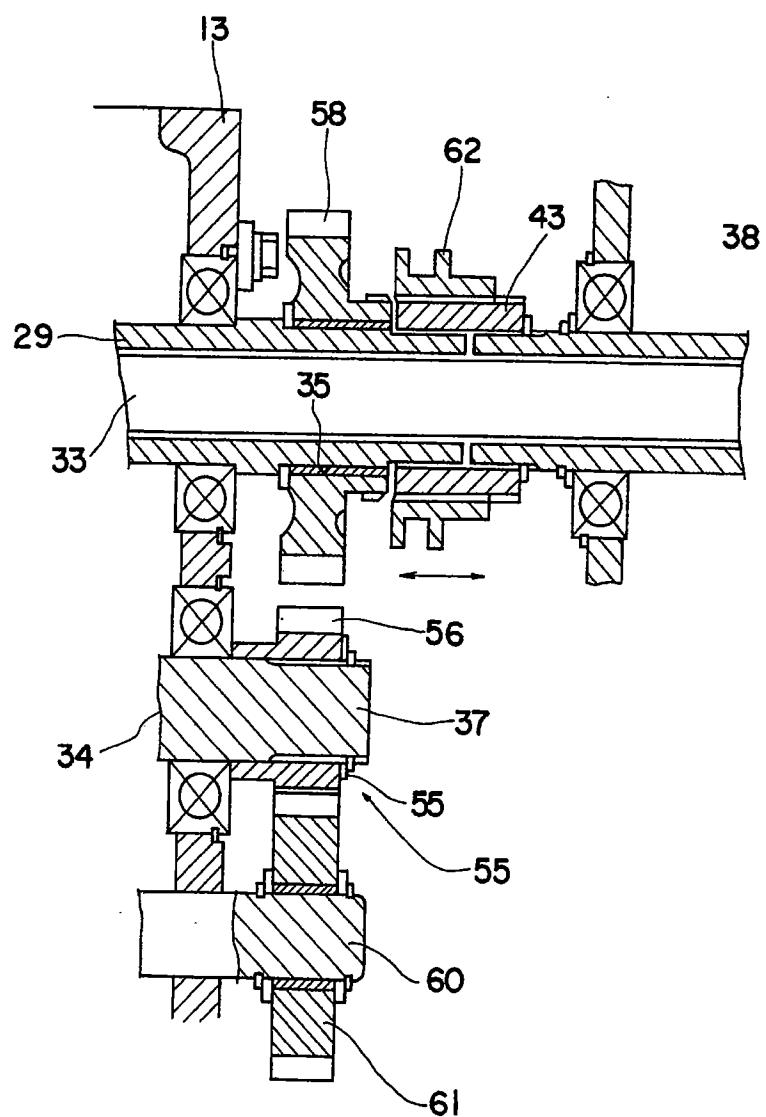
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Fig 7

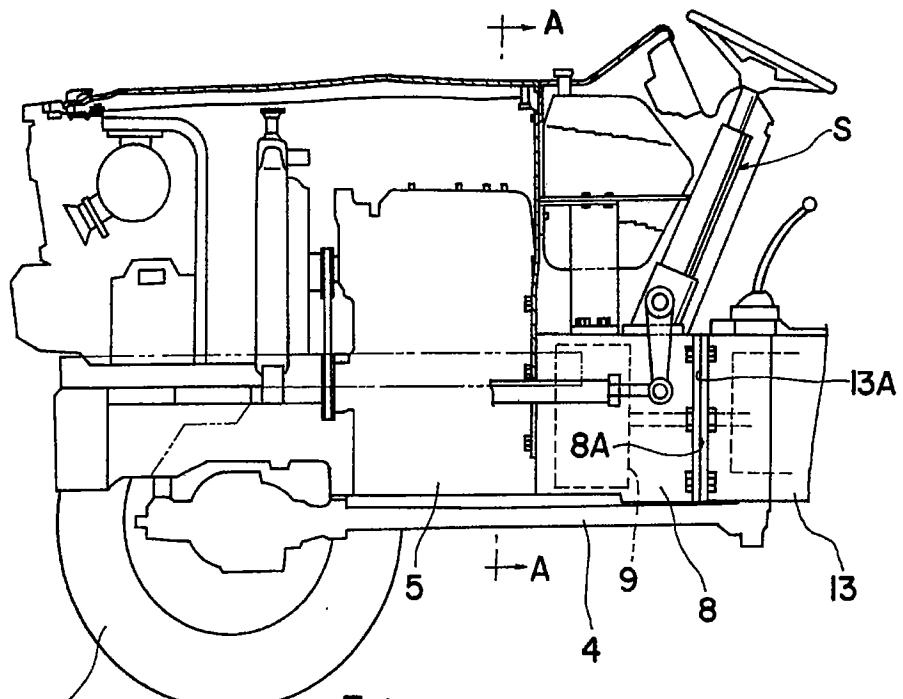
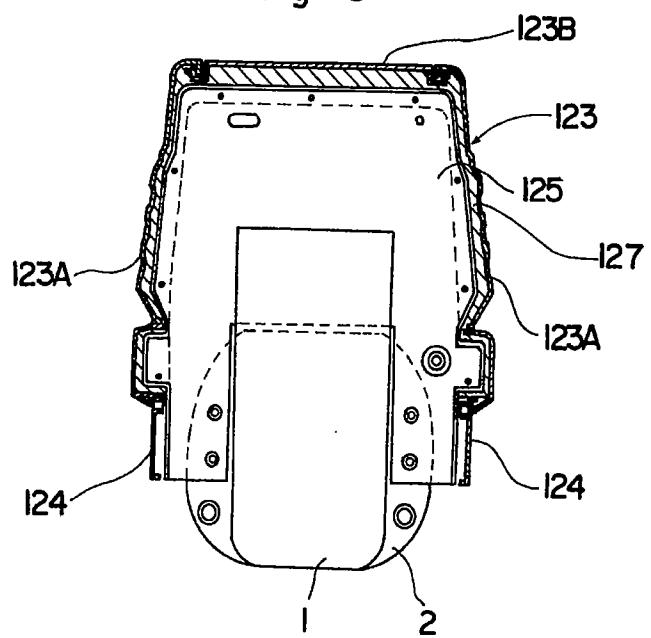


Fig 8



## SPECIFICATION

## Tractor transmission

5 This invention relates to improvements in a tractor transmission.

Unlike a passenger car, a tractor requires a transmission providing a multistep change speed at great reduction ratios in order to carry out varied 10 operations.

There is a known tractor transmission which includes a backward and forward switching mechanism or so-called shuttle transmission mounted forwardly of a primary change speed mechanism to 15 suit, for example, a loading and unloading operation which involves a frequent repetition of backward and forward movements. Such a transmission has the disadvantage of having to change a wheelbase when, for example, a secondary change speed 20 mechanism mounted rearwardly of the primary change speed mechanism and providing two speeds is modified or replaced with a new mechanism to provide three speeds.

Where a high speed and low speed switching 25 mechanism is mounted forwardly of the primary change speed mechanism, it is sufficient that the secondary change speed mechanism provides two forward speeds and one backward speed. But in this instance the primary change speed mechanism must 30 incorporate the backward and forward switching mechanism, which results in complicated construction and necessitates a change of the wheelbase.

An object of this invention is to provide a tractor transmission which accommodates the high speed 35 and low speed switching mechanism and the backward and forward switching mechanism without necessitating any changes to the primary change speed mechanism and the wheel base.

In order to achieve the above object this invention 40 provides a tractor transmission permitting an output of an engine to be transmitted to a primary change speed mechanism housed in a first transmission case through a clutch mechanism in a clutch housing, the first transmission case being removably 45 attached to a rear wall of the clutch housing, wherein the first transmission case includes a space in a forward portion thereof for accommodating a backward and forward switching mechanism and a high speed and low speed switching mechanism, inter- 50 changeable with each other, removably attached to the rear wall of the clutch housing facing the space to transmit the output of the engine to the primary change speed mechanism.

Thus, the transmission according to this invention 55 is capable of accommodating the high speed and low speed switching mechanism and the backward and forward switching mechanism (or shuttle transmission), interchangeable with each other and attached to the rear wall of the clutch housing, in the 60 space defined forwardly of the primary change speed mechanism, without changing the wheelbase of the tractor.

The invention, therefore, enables a tractor to be manufactured at low cost, which is movable back 65 and forth at varies speeds to carry out many different

operations efficiently.

The invention will now be further described, by way of example, with reference to the accompanying drawings which show embodiments of this invention, and in which:-

*Figure 1* is a side view of a tractor,

*Figure 2* is a sectional side view of one form of transmission,

*Figure 3* is a sectional view of a shuttle portion of

75 *Figure 2*,

*Figure 4* is a sectional side view of another form of transmission,

*Figure 5* is an enlarged rear view of a reversing mechanism,

80 *Figure 6* is a developed sectional view of *Figure 5*, *Figure 7* is a schematic side view of a forward portion of the tractor, and

*Figure 8* is a sectional view taken on line A-A of *Figure 7*.

85 *Figure 1* shows a four-wheeled tractor 1 having a right and left pair of front wheels 2 and a right and left pair of rear wheels 3. The front wheels 2 in this example are dirigible wheels and at the same time drive wheels which are driven by a propeller shaft 4

90 in timed or synchronous relationship with the rear wheels 3.

An engine 5 is operatively connected to the rear wheels 3 and a power takeoff shaft through a clutch mechanism and change speed mechanisms housed

95 in a frame 6 connected to a rear face of the engine.

Referring to *Figure 2* showing an interior of the frame 6, a flywheel housing 7 is secured to the rear face of the engine by bolts (not shown), and a clutch housing 8 is secured to the flywheel housing 7 by

100 bolts (not shown). The two housings contain the clutch mechanism 9 which is put in and out by a clutch release mechanism 10 to connect and disconnect a drive propeller shaft 11 and a power takeoff propeller shaft 12, respectively. In this example the

105 propeller shaft 11 is a sleeve shaft containing the propeller shaft 12. The clutch mechanism 9 is a two-step depression type double clutch.

A first transmission case 13 is removably attached at a forward end thereof to a partition wall 14 of the

110 clutch housing 8 by bolts or the like (not shown). The first transmission case 13 contains, in this embodiment, a primary change speed mechanism 15 having gears in constant mesh and providing four speeds.

A second transmission case 16 contains a secondary change speed mechanism 18 operatively connected to a differential 17. The second transmission case 16 is removably attached at a forward end

115 thereof to the first transmission case 13 by bolts or the like (not shown) to permit operative connection between the primary change speed mechanism 15 and the secondary change speed mechanism 18.

Thus, in this example, the frame 6 consists of the flywheel housing 7, the clutch housing 8 and the first and second transmission cases 13, 16.

120 A backward and forward switching mechanism or shuttle transmission mechanism 19 includes a backward and forward switching shifter 20. This mechanism 19 is supported by a casing 21 and is removably attached to the partition wall 14 by bolts or the like

130 (not shown) according to this embodiment. The

switching mechanism 19 includes gears 22 and 23 removably splined to or otherwise mounted on the propeller shaft 11, and gears 25 and 26 rotatably mounted on an output shaft 24 supported by the casing 21. The gears 22 and 25 are operatively connected to each other by an idle gear 28 supported by a shaft 27 as shown in Figure 3, and the gears 23 and 26 are directly connected to each other. The output shaft 24 is rotatable in opposite directions by 10 sliding the shifter 20.

The casing 21 is mounted in the first transmission case 13 forwardly of the primary change speed mechanism 15, and for this purpose a space 27 is provided in the forward portion of the first transmission case 13. Whilst in this embodiment the casing 21 is attached to the partition wall 14, the casing 21 may be attached to the first transmission case 13 so long as it is disposed in the space 27.

The primary change speed mechanism 15 comprises a plurality of change speed gears 30 having varied diameters and rotatably mounted on a tubular change speed shaft 29 supported through bearings by upper wall portions of the first transmission case 13, and a plurality of change speed gears 32 mounted on an input shaft 31 supported through bearings below the change speed shaft 29, the gears 31 being shiftable into and out of engagement with the gears 32 opposed thereto. The change speed shaft 29 contains therein a power takeoff transmission shaft 33 which is connected to the propeller shaft 12 by a coupler 34. The change speed shaft 29 has a rear portion 35 extending through a rear wall of the first transmission case and including a stepped portion.

35 The input shaft 31 is connected at a forward end thereof to the output shaft 24 of the switching mechanism 19 by a coupler 36 and has a rear portion 37 projecting from the rear wall of the first transmission case 13 and defining a spline thereon.

40 The secondary change speed mechanism 18 comprises in this embodiment, a plurality of change speed gears 39 having varied diameters and fixedly mounted on a tubular change speed shaft 38 supported by upper portions of the second transmission case 16, and a plurality of gears 41 having varied diameters and rotatably mounted on a drive pinion shaft 40 extending below and parallel to the change speed shaft 38, the gears 41 being brought into and out of engagement with the gears 39 by sliding a shifter 42 to provide two speeds. The drive pinion shaft 40 is operatively connected to the differential 17. The change speed shaft 38 is coaxial with and connected by a coupler 43 to the change speed shaft 29 of the primary change speed mechanism. The drive pinion shaft 40 is coaxial with the input shaft of the primary change speed mechanism, and carries a front wheel drive gear 44 fixed thereto.

55 The second transmission 16 housing the secondary change speed mechanism 18 includes a space 45 in a forward portion thereof. The power takeoff transmission shaft 33 extends through the interior of the change speed shaft 39 to be operatively connected to a power takeoff shaft 47 via a power takeoff change speed mechanism 46 housed in a 60 rear portion of the second transmission case 16.

The transmission shown in Figure 2 includes the shuttle transmission mechanism mounted in the space 27 forwardly of the primary change speed mechanism 15, so as to be suitable for a loading and 70 unloading operation or the like which involves a frequent repetition of to and fro movements. This transmission of Figure 2 permits the secondary change speed mechanism 18 to be modified to provide three speeds by using a longitudinal allowance provided by the space 45 in the forward portion of the second transmission case 16. Such a modification requires no change to be made to the primary change speed mechanism 15 or to the cases and housing.

75 80 Figure 4 shows an embodiment in which the described shuttle transmission mounted in the space 27 is replaced by a so-called high and low transmission mechanism 48 which switches between a high speed and a low speed.

85 More particularly, referring to Figure 4, different diameter gears 49 and 50 are splined to the propeller shaft 11, and high speed and low speed gears 52 and 53 are mounted on an output shaft 54 supported by a casing 51 to be brought into and out of engagement 90 with the gears 49 and 50 by a shifter so as to switch between the high speed and low speed. The output shaft 54 is operatively connected to the input shaft of the primary change speed mechanism.

To assemble these transmission mechanisms, the 95 clutch housing 8 and the first transmission case 13 are separated from each other, the casings 21 and 51 containing the respective transmission mechanisms are selectively attached to the rear face of the partition wall 14, and the first transmission case 13 is 100 fitted forwardly to be secured to the partition wall 14 by bolts (not shown).

Where the high speed and low speed switching mechanism 48 is mounted forwardly of the primary change speed mechanism 15, it is sufficient that the 105 secondary change speed mechanism provides two forward speeds and one backward speed. But, if a reversing mechanism is incorporated into the primary change speed mechanism 15, the latter loses the advantage of being usable with the backward and 110 forward switching mechanism.

Thus the reversing mechanism 55 is removably mounted in the forward space 45 of the second transmission case 16, that is between an output side of the primary change speed mechanism and an 115 input side of the secondary change speed mechanism, as shown in Figure 4.

Referring to Figures 5 and 6, the reversing mechanism 55 includes a gear 56 mounted on the projecting portion 37 and stopped by a collar 57 or 120 the like from coming off, and a back gear 58 rotatably mounted on the projecting portion 35, the two gears 56 and 58 being operatively connected to each other through an intermediate gear 61 on a shaft 60 supported by arm means 59 projecting from the lateral wall of the transmission case 16. The coupler 125 43 has a splined outer periphery on which a shifter 62 is slidably mounted to bring the reversing mechanism 55 into and out of operation.

In Figure 5, 63 denotes a shift lever for a first speed 130 and a second speed, 64 denotes a shift lever for a

third speed and a fourth speed, and 65 denotes a shift lever for backing, the shift levers having their respective shift forks 66, 67 and 68. The shift levers 63, 64 and 65 are selectively engaged by an engaging element 70 attached to a transversely slidable selector bar 69. Speed changes are effected through a selecting operation and a shifting operation of a single lever 71 connected to the selector bar 69.

In the transmission shown in Figure 4, the primary change speed mechanism 15 is provided with high and low transmission mechanism 48 to switch between a high speed and a low speed, to which the differential 17 is operatively connected through the primary change speed mechanism 15 and the secondary change speed mechanism 18, and the reversing mechanism 56 is adapted to provide one backward speed. The primary change speed mechanism 15 shown in Figure 2 is used intact in this embodiment.

In Figures 2 and 4, 72 denotes a transmission shaft 20 for driving the front wheels, which extends from the second transmission case through the first transmission case in parallel with the other shafts and includes a clutch 73 at an intermediate position thereof to establish and break power transmission. 25 This transmission shaft 72 carries a gear 74 in mesh with the drive gear 44, and has a front power takeoff mechanism 75 at a forward end thereof. The power takeoff mechanism 75 operatively connects the transmission shaft 72 to the propeller shaft 4. The 30 power takeoff mechanism 75 is contained in a recess 76 defined in a bottom portion of the clutch housing 8, the recess 76 being closed by a case 77.

As can be seen, this invention provides a transmission in which the output of the engine 5 is transmitted through the clutch mechanism 9 to the primary change speed mechanism 15 in the first transmission case 13 and to the secondary change speed mechanism 18 in the second transmission case 16, and its characterizing features lie in that the first 40 transmission case 13 is removably attached at the forward end thereof to the engine side and the second transmission case 16 is removably attached at the forward end thereof to the rear end of the first transmission case 13, that the casings 21 and 51 45 containing the different types of transmission mechanism 19 and 48 are interchangeably mounted on the input side of the primary change speed mechanism 15, that the first transmission case 13 provides the space 27 in the forward position thereof 50 to accommodate the casings 21 and 51, that the receiving mechanism 55 is removably mounted between the output side of the primary change speed mechanism 15 and the input side of the secondary change speed mechanism 18, and that 55 the second transmission case provides the space 45 in the forward portion thereof to accommodate the reversing mechanism 55. This construction has the following advantages.

The transmission is well suited for an operation 60 involving a frequent repetition of to and fro movements, when the shuttle transmission mechanism 19 is mounted forwardly of the primary change speed mechanism 15 and operatively connected to the second change speed mechanism 18. On the other hand, when the high speed and low speed transmis-

sion mechanism 48 is mounted forwardly of the primary change speed mechanism 15, the reversing mechanism 55 is mounted in the space 45 defined in the second transmission case 16. At this time the

70 same primary change speed mechanism 15 is utilized as when the shuttle transmission mechanism 19 is mounted, and besides there is no need to change the wheelbase. Therefore, transmissions according to the intended purposes can be mass produced at a 75 manufacturing plant by putting components to combined use, as a result of which a substantial cut in manufacturing costs may be expected.

Referring now to Figure 7 showing a forward portion of the tractor, the tractor frame includes the 80 clutch housing 8 containing the clutch mechanism 9 and connected to the engine 5. The first transmission case 13 has a forward end opening face 13A detachably connected to a rear end opening face 8A of the clutch housing 8. A steering wheel assembly S 85 is disposed at the side of the two interconnected end opening faces 8A and 13A opposed to the engine 5.

Referring to Figure 8 which is a section taken on line A-A of Figure 7, 123 denotes a bonnet comprising lateral portions 123A and a top portion 123B, the 90 latter being adapted to open laterally. 124 denotes a right and left pair of frames supported by lateral walls of the clutch housing 8 and 125 denotes a heat insulator plate, whilst 127 denotes elastic packing formed of sponge, rubber or the like disposed 95 between the frames 124 and the insulator plate 125.

The above construction has an advantage in that the steering wheel assembly S need not be disassembled when the clutch housing 8 and the first transmission case 13 are separated from each other, 100 which is frequently carried out, for maintenance of the clutch mechanism 9.

## CLAIMS

- 105 1. A tractor transmission permitting an output of an engine to be transmitted to a primary change speed mechanism housed in a first transmission case through a clutch mechanism in a clutch housing, said first transmission case being removably attached to a forward end of said clutch housing, wherein said first transmission case includes a space in a forward portion thereof for accommodating a backward and forward switching mechanism and a high speed and low speed switching mechanism, 110 interchangeable with each other, removably attached to the rear wall of said clutch housing, facing said space to transmit said output of the engine to said primary change speed mechanism.
- 115 2. A tractor transmission as claimed in claim 1, further comprising a second transmission case removably attached to a rear end of said first transmission case and housing a secondary change speed mechanism.
- 120 3. A tractor transmission as claimed in claim 2, further comprising a reversing mechanism mounted between said primary change speed mechanism and said secondary change speed mechanism to cooperate with said high speed and low speed switching mechanism.
- 125 4. A tractor transmission as claimed in claim 3,

wherein said reversing mechanism is disposed in a space defined in a forward portion of said second transmission case.

5. A tractor transmission as claimed in claim 2, 3 or 4, wherein said clutch housing has a bottom defining a recess receiving a front power takeoff mechanism to take out power from said secondary change speed mechanism.
6. A tractor transmission as claimed in any preceding claim, wherein said clutch housing has a flywheel housing removably attached thereto.
7. A tractor transmission substantially as hereinbefore described with reference to the accompanying drawings.
- 15 8. A tractor including a transmission as claimed in any of the preceding claims.

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